

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
30 June 2005 (30.06.2005)

PCT

(10) International Publication Number
WO 2005/059473 A2

(51) International Patent Classification⁷: **G01C 15/00**

(21) International Application Number:
PCT/EP2004/014365

(22) International Filing Date:
16 December 2004 (16.12.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
103 59 415.9 16 December 2003 (16.12.2003) DE

(71) Applicant (for all designated States except US): TRIMBLE JENA GMBH [DE/DE]; Carl-Zeiss-Promenade 10, 07745 Jena (DE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **VOGEL, Michael** [DE/DE]; Dorfstrasse 29, 07629 Schleifreisen (DE).

(74) Agents: **FRANK, Dierk et al.**; Geyer, Fehnert & Partner, Perhamerstrasse 31, 80687 München (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2005/059473 A2

(54) Title: CALIBRATION OF A SURVEYING INSTRUMENT

(57) **Abstract:** A method for calibrating a surveying instrument is disclosed the survey instrument comprising a base element and a camera with an image sensor, the camera being rotatable about a vertical axis fixed with respect to said base element and being rotatable about a tilting axis, the tilting axis being rotated about the vertical axis with rotation of the camera about the vertical axis, In the method, data associated with calibration points and images of the calibration points on the image sensor captured in different faces are used, the data for each of said calibration points comprising distance data representing a distance between each said calibration point and the surveying instrument and the data for each of the images of each said calibration point comprising image position data representing the position of the image of each said calibration point on said image sensor and orientation data representing a horizontal angle of rotation of the tilting axis about the vertical axis and a vertical angle of tilting of the camera about the tilting axis. Further, on the basis of the distance data for each of the calibration points and the image position and orientation data for each of the images of the calibration points the surveying instrument is calibrated simultaneously taking into account at least one optical property of camera and at least one of the relative orientation of the vertical axis and the tilting axis and the orientation of the camera relative to one of the base element, the vertical axis and the tilting axis.